EVENSON, McKEOWN, EDWARDS & LENAHAN, P.L.L.C.
1200 G Street, N.W., Suite 700
Washington, D.C. 20005
(202) 628-8800

September 3, 1999

Box PATENT APPLICATION
Assistant Commissioner
for Patents
Washington, D.C. 20231

Re: New U.S. Patent Appln.
Our Ref.: 225/48098

Sir:

Transmitted herewith for filing is application of:

Patrick IZQUIERDO
Karl-Heinz KAISERAUER
Michael LAHRES
Oliver STORZ

Entitled: **METHOD FOR SURFACE TREATMENT OF THE INTERIORS OF ENGINE CYLINDER BORES, AND CYLINDERS MADE BY SAID METHOD**

Enclosed are:

1. Specification, including 23 claims (9 pages).

2. 1 Sheet of _____ Formal 3 Informal drawings showing Figs. 1-3.

3. X Declaration and Power of Attorney **(unexecuted)**.

4. Priority is being claimed under 35 U.S.C. §119 and 37 C.F.R. §1.55 based on Priority Document 198 40 117.5, filed in GERMANY on September 3, 1998.

5. The filing fee has been calculated as shown below:

Basic Fee					$380/760	= $760.00
Total Claims	23	- 20	= 3	x	$ 9/18	= $ 54.00
Independent Claims	2	- 3	= 0	x	$39/78	= $ 0
Multiple Dependent Claim Presented					$130/260	= $ 0
Total Filing Fee						$814.00

The filing fee is being deferred.

Respectfully submitted,

September 3, 1999

Donald D. Evenson
Registration No. 26,160

DDE:JMV:atc

METHOD FOR SURFACE TREATMENT OF THE INTERIORS OF ENGINE CYLINDER BORES, AND CYLINDERS MADE BY SAID METHOD

BACKGROUND AND SUMMARY OF THE INVENTION

This application claims the priority of German application 198 40 117.5, filed September 3, 1998, the disclosure of which is expressly incorporated by reference herein.

The present invention relates to a method for surface treatment of the interiors of hollow bodies, especially cylinder bores as preparation for applying a thermally sprayed layer, with a portion of the material forming the interior being removed and a surface with a defined structure and/or quality being produced.

A method according to the species is known from EP 0 716 158 A1. In that patent, a method is described for producing engine blocks with coated cylinder bores in which the engine block is initially cast from a metal and then dirt residue is removed from the walls of the cast cylinder bores so that initially an annular cleaned fresh metal surface is prepared. Then a plasma-sprayed layer is deposited on this pretreated surface and this layer is then finished.

The cylinder bores are usually prepared by machining them with corundum blasting followed by grease removal. The goal is to obtain a grease-free surface with a roughness (R) value of approximately 25 to 65 µm. Roughness (R) is determined by calculating the average peak to valley height of the surface of the machined cylinder bore. The problem is that the cylinder bores must be in precise position following preparation since after casting, the position of the cast cylinder bore can differ significantly from the prescribed value. In the manufacture of engine blocks from hypoeutectic aluminum by die casting, there is the additional problem that as a result of the casting process, inhomogeneities can develop especially in the lower part

of the cylinder bores. Bubbles or pores can form in the material, caused by a shrinking process during casting (so-called shrink holes). During surface treatment and roughening, these pores or bubbles are exposed and can be further enlarged. Blasting residue and solvents or lubricant residues can remain in the open bubbles which results in poor adhesion of the applied tribological layer. Since the coating takes place at high temperatures, the solvent that remains in the open bubbles expands so that depressions and chips further worsens the adhesion of the tribological layer to the wall.

A goal of the present invention therefore is to provide a method of the type described above which provides grease-free surfaces of a certain surface quality in a method that is as simple as possible, onto which surface the thermally sprayed layers can be applied in simple fashion and with good adhesion.

The solution includes dry-cutting the interior in a method step without lubricant using a tool having a defined and/or undefined surface profile.

The term "dry cutting" means that no lubrication is used or that at most minimum lubrication with a volume flow of less than 150 ml/h is used in which the chips or the surface are considered to be dry.

Therefore, provision is made according to the invention for machining the bores when they are dry, for example by drilling, brushing, knurling, circular milling, or combinations of one or several of these methods.

The tool can have a defined surface profile so that after machining, a surface with a defined structure results. Subsequent degreasing or cleaning and roughening are eliminated.

Following surface treatment, a layer can be applied immediately by thermal spraying.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a combustion engine cylinder block, having cylinder bores of the kind to be processed according to preferred embodiments of the present invention;

Figure 2 is a schematic view depicting a dry cutting of a cylinder bore according to preferred embodiments of the present invention; and

Figure 3 is an enlarged schematic sectional view depicting the dry cutting of a cylinder bore according to preferred embodiments of the present invention, to for a predetermined surface S.

DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 depicts a cast internal combustion engine block 1 of the kind to be processed according to the present invention.

Engine block 1 includes a plurality of cylinder bores 2. The cylinder bores 2 are cleaned, then dry cut using a cutting tool T schematically depicted in Figures 2 and 3. The dry cutting is carried out without first applying lubricant (or by applying minimal lubricant with a flow of less than 150 ml/h (milileters per hour) to a respective cylinder bore so that the surfaces are considered as "dry").

The cutting tool T, schematically depicted in Figures 2 and 3, is comprised of cubic boron nitride, polycrystalline diamond, a coated or uncoated hard metal, or a ceramic. Steel wire with or without a coating or ceramic is used as the brush material. As the knurl, any coated or uncoated surface profiles of hard metal or MSS or ceramic can be used. A tool T with a defined surface profile for example can be a cutting tool or a tool fitted with one or more rollers, with the roller comprising a hard metal, ceramic or MSS, coated or uncoated. When a cutting tool T with a defined surface profile is used, preferably one or more cutting devices comprise cubic boron nitride, polycrystalline diamond, a coated or uncoated hard metal, or a cutting ceramic.

The hard metal can be manufactured in particular on the basis of titanium carbide or tungsten carbide. The cutting ceramic can consist especially of silicon nitride or aluminum oxide.

The cutting tool T can be an indexable insert, for example with a certain surface structure. The cutting tool T for example can also be a tool fitted with a plurality of indexable inserts such as a cutting spindle. The cutting tool T can be steel wire with or without a coating or a ceramic or a hard material with an undefined surface profile.

Therefore it is possible with the method according to the invention to prepare cylinder bores in particular with dimensional and position tolerance with certain surface quality for coating with a thermally sprayed layer.

EXAMPLE

The following are parameters of a typical example used for dry cutting the interior of the hollow body and the resulting roughness (R) of the surface of the machined hollow body:

Cutting tool:	TCMW 110208F CD10
RPM:	800 min
Feed:	30 mm/min
Surface Layer:	APS-AlSi25Ni4Fe1.2Mg1.2
Roughness (R):	1.3 µm

The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.

WHAT IS CLAIMED IS:

1. A method for surface treatment of an interior of a hollow body, comprising:

dry cutting the interior of the hollow body using a tool having a surface profile, wherein a portion of the material forming the interior is removed which produces a surface with a certain structure or quality.

2. The method of claim 1, wherein the hollow body is an engine cylinder bore prepared for applying a thermal layer.

3. The method of claim 1, wherein the dry cutting is performed by drilling, brushing, knurling, circular milling or combinations thereof.

4. The method of claim 1, wherein the tool comprises cubic boron nitride, polycrystalline diamond, a coated or uncoated hard metal or a ceramic.

5. The method of claim 4, wherein the tool comprises hard metal comprises titanium carbide or tungsten carbide.

6. The method of claim 4, wherein the tool comprises ceramic silicon nitride or aluminum oxide.

7. The method of claim 1, wherein the tool comprises one or more cutting devices with a defined surface profile.

8. The method of claim 1, wherein the tool comprises one or more cutting devices with a defined surface profile.

9. The method of claim 7, wherein the tool comprises steel wire with or without a coating or a hard material with a undefined surface profile.

10. The method of claim 7, wherein the tool is an indexing insert.

11. The method of claim 7, wherein the tool is fitted with a plurality of indexing inserts.

12. The method of claim 11, wherein the tool is fitted with a cutting spindle.

13. The method of claim 1, wherein the tool is fitted with one or more rollers, wherein the roller comprises coated or uncoated hard metal, ceramic or MSS.

14. A combustion engine cylinder with a bore made by the method of Claim 2.

15. A method for surface treatment of the interiors of hollow bodies, comprising:

dry cutting the interior of the hollow body using a tool having a surface profile, wherein a portion of the material forming the interior is removed and produces a surface with a predetermined quality structure.

16. A method according to Claim 14, further comprising applying a layer to the surface after cutting.

17. The method of claim 15, wherein the layer is a tribological layer.

18. The method of claim 15, wherein the layer is thermally sprayed on the surface.

19. The method of claim 15, wherein said dry cutting is performed with at most 150 ml/h of lubricant applied to the interior of the hollow body.

20. The method of claim 15, wherein the hollow body is a combustion engine cylinder bore.

21. The method of claim 15, wherein the surface profile is a defined surface profile.

22. The method of claim 15,, wherein the surface profile is an undefined surface profile.

23. A combustion engine cylinder with a bore made by the method of Claim 18.

ABSTRACT OF THE DISCLOSURE

A method for surface treatment of the interiors of hollow bodies, especially cylinder bores, in preparation for the application of a thermally sprayed layer. The method comprises dry cutting without a lubricant or with a shortage of lubricant using a tool having a defined and/or undefined surface profile. In this method with a portion of the material forming the interior is removed and produces a surface that has a defined structure and/or quality. This eliminates the need for costly degreasing of the surface following machining.

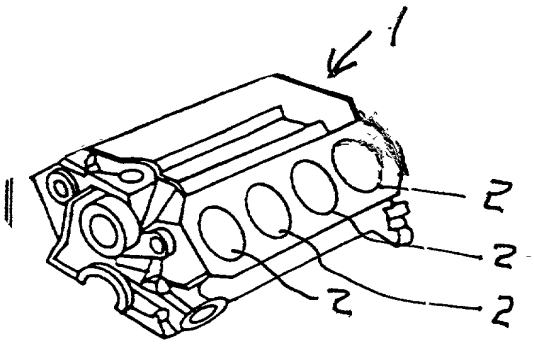

FIG. 1

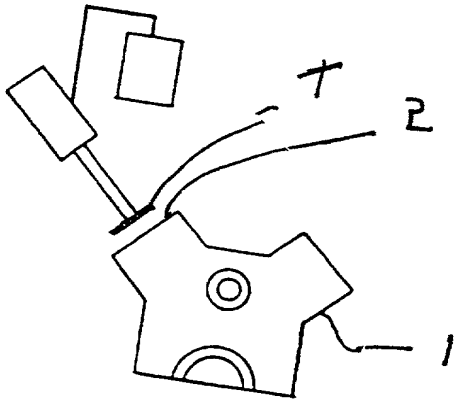

FIG. 2

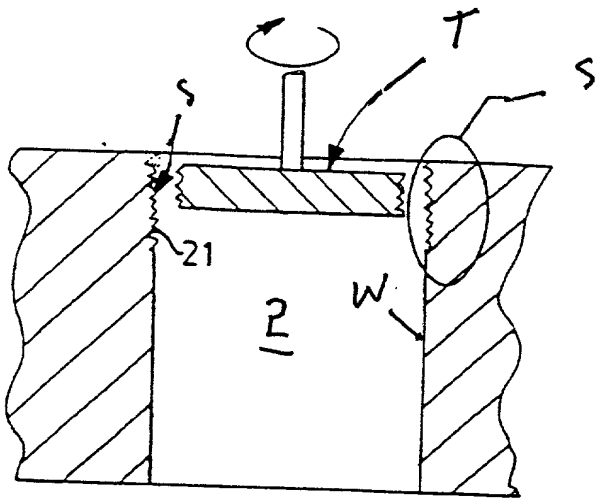

FIG. 3

Attorney Docket No. 225/48098

DECLARATION AND POWER OF ATTORNEY - PATENT APPLICATION

As a below named inventor, I hereby declare that my citizenship, postal address and residence are as stated below; that I verily believe I am the original, first and sole inventor (if only one inventor is named below) or a joint inventor (if plural inventors are named below) of the invention entitled:

METHOD FOR SURFACE TREATMENT OF THE INTERIORS OF ENGINE CYLINDER BORES, AND CYLINDERS MADE BY SAID METHOD

the specification of which

__X__ is attached hereto, or

_____ was filed on _____ as Application Serial No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to be material to patentability as defined in 37 CFR §1.56. I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed
198 40 117.5 (Number)	Germany (Country)	03 / 09 / 98 (Day/Month/Year)	YES
(Number)	(Country)	(Day/Month/Year)	

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose all information known to be material to patentability as defined in 37 CFR §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status)

I hereby appoint as principal attorneys Martin Fleit, Reg. No. 16,900; Herbert I. Cantor, Reg. No. 24,392; James F. McKeown, Reg. No. 25,406; Donald D. Evenson, Reg. No. 26,160; Joseph D. Evans, Reg. No. 26,269; Gary R. Edwards, Reg. No. 31,824; Jeffrey D. Sanok, Reg. No. 32,169; Richard R. Diefendorf, Reg. No. 32,390; and Paul A. Schnose, Reg. No. 39,361, to prosecute and transact all business in the Patent and Trademark Office connected with this application and any related United States and international applications. Please direct all communications to:

Evenson, McKeown, Edwards & Lenahan, P.L.L.C.
1200 G Street, N.W., Suite 700
Washington, D.C. 20005
Telephone: (202) 628-8800
Facsimile: (202) 628-8844

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

INVENTOR:	**Patrick IZQUIERDO**
Citizenship:	German
Post Office Address/ Residence:	Sedan Strasse 27 89077 Ulm GERMANY

_____ _____
(date) (signature of 1st inventor)

INVENTOR: **Karl-Heinz KAISERAUER**
Citizenship: German
Post Office Address/ Residence: Steinenberg 22
89584 Ehningen-Erbstetten GERMANY

_____ _____
(date) (signature of 2nd inventor)

INVENTOR: **Michael LAHRES**
Citizenship: German
Post Office Address/ Residence: Besserstrasse 33
89073 Ulm GERMANY

_____ _____
(date) (signature of 3rd inventor)

INVENTOR: **Oliver STORZ**
Citizenship: German
Post Office Address/ Residence: Ingebrog-Bachmann-Strasse 29
89134 Blaustein GERMANY

_____ _____
(date) (signature of 4th inventor)